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QUERY. "In the Treatise on the elements of Geometry by Rouche′ and Comberoucse, some miscellaneous problems in solid geometry are proposed, among which is the following:—'Draw a sphere which shall cut five other spheres under equal angles.'—Can any reader of the ANALYST refer me to a solution, or if not, give one."

ANSWER BY R. J. ADCOCK.

LET r_1, r_2, r_3, r_4, r_5 be the radii of the given spheres, (x_1, y_1, z_1), (x_2, y_2, z_2), &c., the coordinates of their centres, δ the radius of the required sphere and α, β, γ, the coordinates of its centre. And put $A =$ the angle of intersection. Then the square of the line joining the centres of the spheres r_1 and δ is

$$(x_1-\alpha)^2+(y_1-\beta)^2+(z_1-\gamma)^2 = r_1^2+\delta^2\pm 2r_1\delta\cos A; \quad \text{hence}$$

$$\begin{aligned}\pm\cos A &= \frac{(x_1-\alpha)^2+(y_1-\beta)^2+(z_1-\gamma)^2-r_1^2-\delta^2}{2r_1\delta}\\ &= \frac{(x_2-\alpha)^2+(y_2-\beta)^2+(z_2-\gamma)^2-r_2^2-\delta^2}{2r_2\delta}\\ &= \frac{(x_3-\alpha)^2+(y_3-\beta)^2+(z_3-\gamma)^2-r_3^2-\delta^2}{2r_3\delta}\\ &= \frac{(x_4-\alpha)^2+(y_4-\beta)^2+(z_4-\gamma)^2-r_4^2-\delta^2}{2r_4\delta}\\ &= \frac{(x_5-\alpha)^2+(y_5-\beta)^2+(z_5-\gamma)^2-r_5^2-\delta^2}{2r_5\delta},\end{aligned}$$

four equations for the four quantities α, β, γ, δ, which completely determine the required sphere.

PROBLEMS.

175. BY NEWTON FITZ, NORFOLK, VIRGINIA.—Find the roots of the equation

$$x^4 + Ax^3 + Bx^2 + Cx + \frac{C^2}{A^2} = 0.$$

176. BY PROF. ORSON PRATT, SEN., SALT LAKE CITY, UTAH.—Given

$$u = F\,(y),\ \text{and}\ y = F'[z + xvf\,(y)];$$

also

$$v = F_1(t),\ \text{and}\ t = F_2[z + xvf_1(t)],$$

to expand (by the differential calculus) u in a series of ascending, positive and integral powers of x. (x not being a function of z.)